Efficient Frontier

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Efficient Frontier

William J. Bernstein

Of Mines, Forests, and Impatience

Capital value is income capitalized, and nothing else.— Irving Fisher

Several years ago, my brother-in-law tossed in my direction a well-thumbed tome entitled *The Theory of Interest*. Grinning like a man relieved of no small burden, he said, "Hey Bill, you're gonna love this one." Written by Irving Fisher in 1930, the text has been the bane of generations of B-school grads: it's formidable but quite well written, repetitious enough that you're not going to miss his basic points.

The book answers the question, "What is a thing worth?" Be it a hot dog, house, or human being. The answer, simply: the pleasure and income it provides. For an immediately-consumed item, the answer is evident—you do not purchase a dinner for $5, $25, or $125 unless it provides you with that measure of sustenance and enjoyment.

Next, suppose someone offers to sell you a meal listed on the menu at $25 *for consumption ten years hence?* How much would you be willing to pay for it now, ten years in advance? Certainly much less than $25. Say I've decided that $5 sounds about right. Punch the numbers into my trusty TI BA-35 and out pops an interest rate of 17.46%. That's my own personal "restaurant-meal interest rate."

The key is that a pleasure enjoyed today is almost always worth more than one enjoyed in the future. Fisher elegantly calls this the "impatience" for the item in question; it's synonymous with the rate of interest we calculated. (There are rare cases when the opposite is true, where a negative item-specific rate of interest occurs. Maybe you suspect that in ten years we are likely to fall prey to war or famine. In that case, you might very well be willing to pay a premium today for a meal ten years hence. However, *money* rates of interest are never negative.)

Of course, you can have different impatience (or interest rates) for different items. Further, the rate for a given item depends on personal circumstances: A starving person's impatience for food is much higher than that of someone who is well-fed. And looking at it yet another way, a prosperous person is willing to spend much more today for a meal ten years hence than a pauper. There are other intrinsic personal characteristics that determine impatience (or rate of interest)— wastrels are by nature profligate and have high impatience; thrifty people have low impatience.

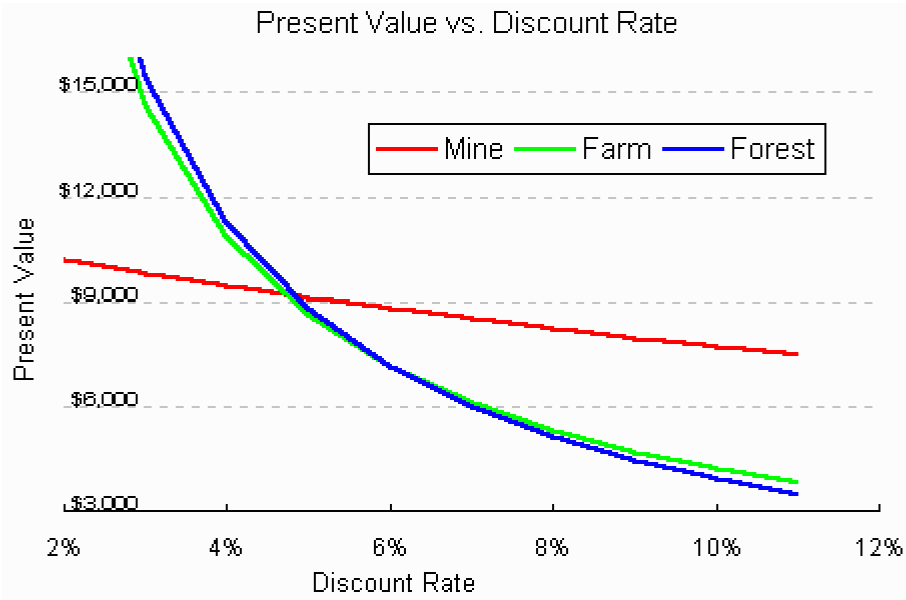
We are talking here about what subsequently became known as *discounting*. A *future* pleasure or service is worth considerably less *in present value* than an immediate one. Thus, its value must be *discounted to the present* by the appropriate rate of interest.

What of a durable item, such as a house? It provides you with shelter and pleasure, not just now but over a very long period of time. What you must do then is estimate how much benefit the house will give you in each future year. For each year, you must discount the value by the appropriate rate of interest. Finally, you add up all of the discounted-to-the-present values for all years in the future; this infinite sum is the true value of the house to you. (This is quite distinct from the *market* value of the house. If the market value is higher than the value calculated from the disount method, you are likely better off renting. But that's another article.) For example, let's suppose that the rate of "house interest" is 9%. The value in each year must be divided by $(1.09)^n$, where *n* is the number of years at that point. Thus, in year 10, divide by 2.37 or $(1.09)^{10}$; in year 20, divide by 5.6 or $(1.09)^{20}$.

Investments fit neatly into this scheme. Fisher employs a paradigm that is quaint yet not displeasing to the modern audience: the purchase of a mine, farm, or forest. A mine produces ore for a relatively brief period of time, with the highest returns in the first years, gradually falling to zero as it is played out. A farm, on the other hand, produces a relatively stable output indefinitely into the future. Finally, a newly-planted forest provides no output in its initial years, then gradually increases over time. Let's represent this with the below table.

Year	Mine	Farm	Forest
1	$2,000	$450	$0
2	$1,800	$450	$0
3	$1,600	$450	$300
4	$1,400	$450	$400
5	$1,200	$450	$500
6	$1,000	$450	$500
7	$800	$450	$500
8	$600	$450	$500
9	$400	$450	$500
10	$200	$450	$500
11	$0	$450	$500
Etc.			

Which is the better investment? It all depends on the discount rate. The farm turns out to be the simplest case. It can be considered a perpetuity yielding $450 of income annually. Discounted at 5%, the present value of all its future income is simply $450 divided by 0.05, or $9,000. The present value of the mine or farm must be calculated with a spreadsheet. Below, I've plotted the present value of the mine, farm, and forest versus the discount rate (DR) for varying discount rates.



First, note how an increase in the DR decreases the present value of any investment, since in all cases this decreases the present value of future income. Next, note how the mine does best in a high-interest-rate environment. This is because its output is "front-loaded," largely escaping the increasingly corrosive effect of the DR in later years. Last, note how a low-interest-rate environment favors the "back-loaded" long-term return of the forest. This has important implications for the relative returns of value and growth investing, which will be the subject of an article in the next quarter's journal.

But for now, we're going to examine just what the model tells us about the New Investment Paradigm. I'm indebted to Cliff Asness of AQR Capital Management for providing me with a framework for understanding what the Fisher model (now known as the Discounted Dividend Model or DDM) tells us about the valuation of technology stocks. Quite obviously, the New Economy is the ultimate "forest," to use Fisher's nomenclature. Cisco shareholders, for example, have patiently held onto their stock for the past ten years with nary a dividend check in their mailboxes, clearly expecting compensation sometime in the hereafter. Of course, long-time Cisco shareholders have been rewarded with stunning increases in capital value, thanks to the generosity of ever greater fools. But the unhappy truth is, the life of corporations is nasty, brutish, and quite often short: given enough time, all eventually disappear. If a company produces no dividends before it dies, its net return to investors is zero. That the capital gains of the first investors must be exactly counterbalanced by the capital losses of later investors is an accounting identity, a fact that investors in most dot-coms are just beginning to realize. Quite obviously, the rational buyer of Cisco expects a large heap of future dividends, which he then discounts to the present to obtain the current fair market value.

Mr. Asness suggests an easy way to examine the market's assumptions concerning growth stocks. Here's how it works: Imagine a stock selling at a PE of 100. Further assume it has $1 of earnings per share and thus a share price of $100. In order to command such a multiple, it must be growing its earnings rapidly—say at 40% per year. It is, of course, yielding no dividends yet. Generous suppositions would be as follows:

1. That this stock maintains its high growth rate for five years without paying a dividend.

2. After these first five years, it begins paying out 50% of its earnings as dividends.

3. In years six to ten, its earnings growth gradually falls to that of the average company.

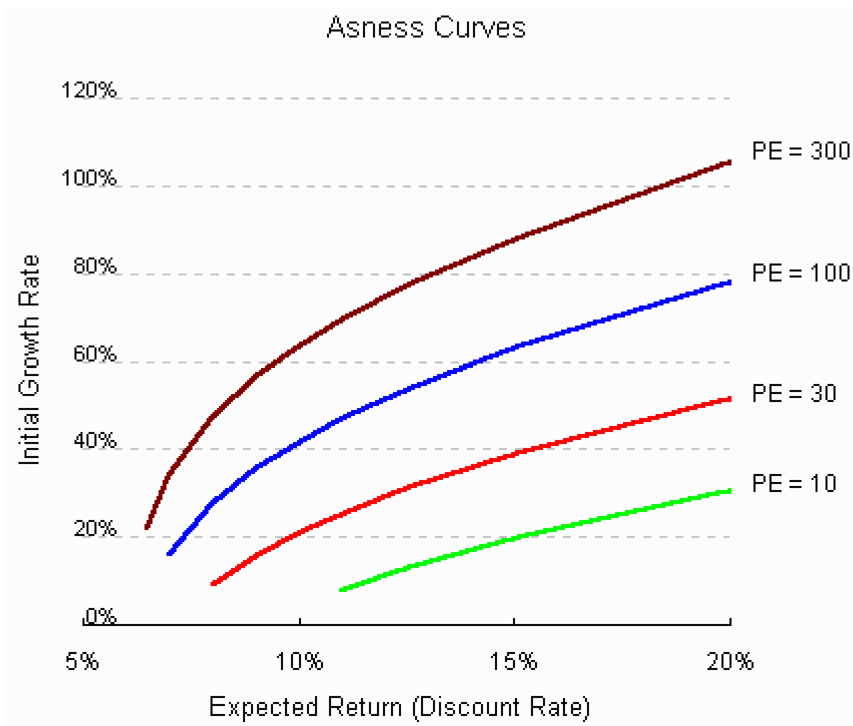
4. Finally, that the market's overall earnings growth rate is 6%.

We now have defined the company's dividend stream, which we can discount at a given rate. *This discount rate is, of course, the stock's expected return*. Thus, we have two parameters to play with: the stock's initial growth rate and its discount rate (or expected return). We fiddle with these two until the sum of all the discounted dividends equals the market price. This is a bit complex, so I'll show you what the top of the spreadsheet table looks like, where I've matched the market price with the sum of all the discounted dividends. (The sum, an infinite sum of all values in the last column, is not visible in the table. As you can see, after peaking at $3.22 in year 10, the discounted dividend then falls off slowly; the infinite sum is a finite value, in this case $101.43.)

Year	Growth	Earnings	Dividend	Discounted Dividend
1	42.0%	$1.42		
2	42.0%	$2.02		
3	42.0%	$2.86		
4	42.0%	$4.07		
5	42.0%	$5.77		
6	36.0%	$7.85	$3.93	$2.22

7	30.0%	$10.21	$5.10	$2.62
8	24.0%	$12.66	$6.33	$2.95
9	18.0%	$14.94	$7.47	$3.17
10	12.0%	$16.73	$8.36	$3.22
11	6.0%	$17.73	$8.87	$3.11
12	6.0%	$18.80	$9.40	$2.99
13	6.0%	$19.92	$9.96	$2.89
14	6.0%	$21.12	$10.56	$2.78
15	6.0%	$22.39	$11.19	$2.68
16	6.0%	$23.73	$11.86	$2.58
17	6.0%	$25.15	$12.58	$2.49
18	6.0%	$26.66	$13.33	$2.40
19	6.0%	$28.26	$14.13	$2.31
20	6.0%	$29.96	$14.98	$2.23
Etc.				

In order to understand the above table, the stock is assumed to have earnings per share of $1.00 in year zero, growing initially at 42% per year. Its dividend stream, beginning in year six, is then discounted at 10% each successive year, yielding the value of these dividends *discounted to the present* in the last column. These discounted dividends are then infinitely summed, obtaining the present value of the stock. What is done in practice is vary both the DR and the initial growth rate to produce the desired present value, say $100, which corresponds to a current PE of 100. In the above example, the initial growth rate of 42% combined with a DR of 10% yields a stock price (PE) of $101.43. Below, I've plotted some "Asness Curves" which demonstrate how PE, initial growth rate, and DR (expected return) relate to each other.



As you can see, it's not a pretty picture. Focus on the blue (PE = 100) curve. Most investors would expect such a stock to return at least 15% per year. The plot shows that a DR/return of 15% and a PE of 100 implies an initial earnings growth rate of 63% for the first five years, followed by a gradual fall to 6% over the next five years, as postulated in the model. Lower rates of growth produce lower rates of return. Start out at a growth rate of only 28%

and you wind up with 8% returns. And, alas, the investor who expects a 20% return needs a 78% initial growth rate. While it is possible with 20/20 hindsight to pick out the odd company that has turned this trick, the probability of your doing so prospectively with a given stock is nil.

Next, consider that the 100 largest stocks on the Nasdaq sell at a PE of 100. *We're talking now about approximately one-quarter of the capitalization of the U.S. stock market.* The probability that this huge chunk of the economy will grow *en bloc* at 40% to 60% for the next five years is about the same as that of the Empire State Building spontaneously levitating to Beardstown by breakfast tomorrow.

A much more reasonable supposition is that the Nasdaq 100 sits at the far left end of the blue curve with earnings growth in the *teens*, yielding long-term bond-like returns accompanied by Ivana Trump-like volatility. There is nothing to prevent these shares from rising another 50% in the next year. But in the long run, the grim picture painted above is not idle conjecture or opinion. It is mathematical fact.

Finally, I want to be clear about one thing: the Asness model is wildly optimistic (as he himself admits). The real world decay of the most glamorous companies' earnings growth is breathtaking. In their landmark study of earnings growth persistence, Fuller, Huberts, and Levinson (*Journal of Portfolio Management*, Winter 1993) looked at stocks sorted by PE. They found that the top quintile— the most popular growth stocks— increased their earnings about 10% faster than the market in year one, 3% faster in year two, 2% faster in years three and four, and about 1% faster in years five and six. After that, their growth was the same as the market's. In other words, you can count on a growth stock increasing its earnings, on average, about 20% *cumulatively* more than the market over six years. After that, nothing.

Perhaps times have changed since the 1973-1990 period analyzed in the above-cited study. Let's be generous and assume that in the New Era the top quintile can manage a 50% cumulative growth advantage over the market. As I'm writing this, the top quintile of the 1,000 largest stocks with positive earnings sells at an average multiple of 78. A one-time 50% earnings growth advantage does not do much to justify such a valuation relative to the rest of the market (which sells at a PE of about 20).

It would seem, then, that a prerequisite for investing in the New Era is an inability or unwillingness to run the numbers. At some point in the not too distant future, we shall shake our heads and wonder how so many folks confused the forest with a gold mine.

Efficient Frontier

William J. Bernstein

The Expected Return One-Step

After any particularly wrenching period in the markets, I usually get a few calls and messages in the following vein: "You saw how the Nasdaq just got cut off at the knees on no fundamental news… do you still believe that the market is efficient?" To which my stock reply is, "It's efficient all right; it's just not always rational."

Just how rational the markets appear depends on your time frame. Turn on CNBC and you're faced with an asylum narrated by the Three Stooges. But look at market behavior over a 50-year horizon and you've got a well-manicured lawn, tended by Paul Samuelson and Bill Sharpe. As a practical matter, the more attention you pay to Samuelson and Sharpe and the less to the Three Stooges, the better off you are. The choice between focusing your attention on 30-year returns and 1-year returns should be obvious, even if emotionally unsatisfying during market declines.

In November, I attended a conference on fixed-income investing sponsored by *Grant's Interest Rate Observer* and found out that the vicissitudes of market exposure could be much, much worse—I could be a bond manager. For these benighted folks there is no long term, only a terrifying succession of Hobbsean quarters and years; lag the benchmark by more than a nanosecond and you're on the phone to Momma asking about the condition of your old room. In addition, bond managers face a relatively recent, poorly-publicized demon peculiar to debentures—a liquidity crunch straight out of Kafka. You can almost always unload a modest amount of stock with little impact cost; that's one benefit of the increasingly frenetic, highly liquid, equity trading of recent years. In contrast, following the derivatives-driven global financial crisis of 1998, trading in bonds has been as sleepy as the no-load fund desk at Merrill Lynch. One attendee estimated that there were "continuous-market" markets in the debt of only the 60 or so largest issuers. Everything else trades, euphemistically, "by appointment." Which means that if fund redemptions require bond sales, a devastating haircut may prove necessary. Or worse, it may not be possible to obtain a bid at any price.

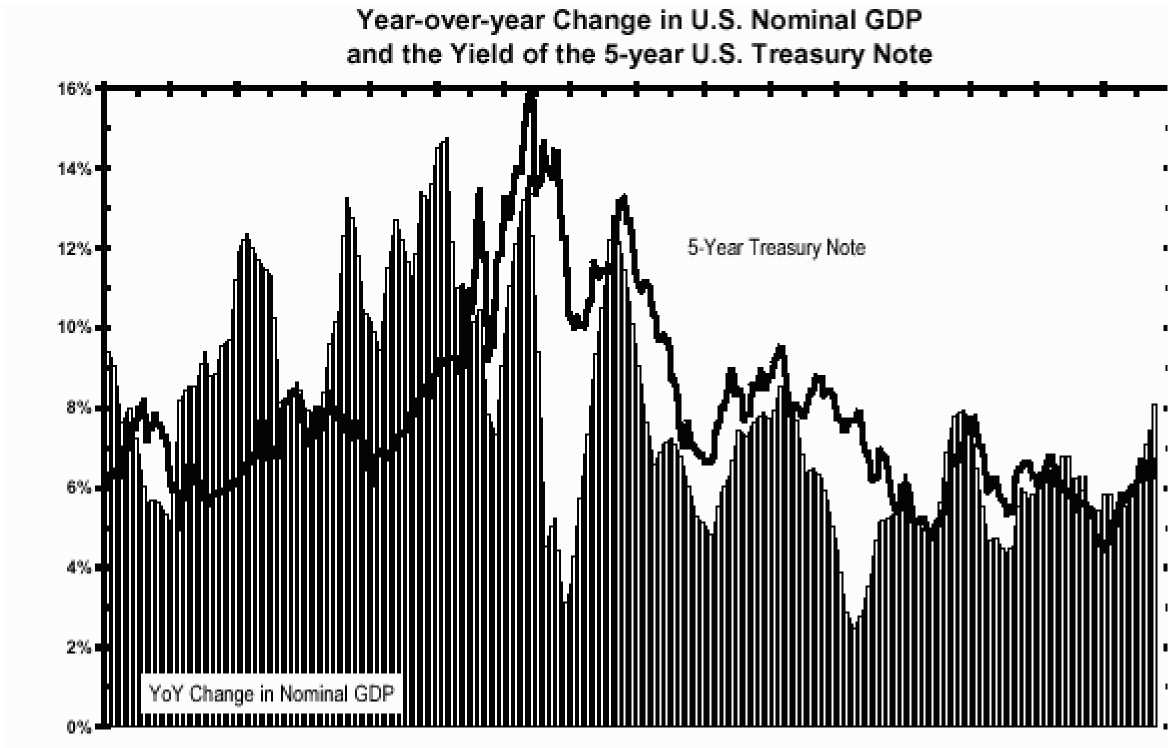
All investors are faced with market (systematic) and specific security (nonsystematic) risk. Nowadays bond managers must also worry about "liquidity risk": the possibility that the market for an otherwise perfectly good bond may simply dry up. Could the same thing happen to equities? Presently, it seems unlikely. But prolonged bear markets usually feature lackadaisical trading, so I wouldn't rule out the possibility.

But I digress. The conference attendees were rewarded by one speaker who did focus on the long term— Jim Bianco (Bianco Research) analyzed expected bond returns through a long lens, testing an intriguing hypothesis: that the primary determinant of bond yields is the growth of GDP and not supply, as is commonly supposed. In his words:

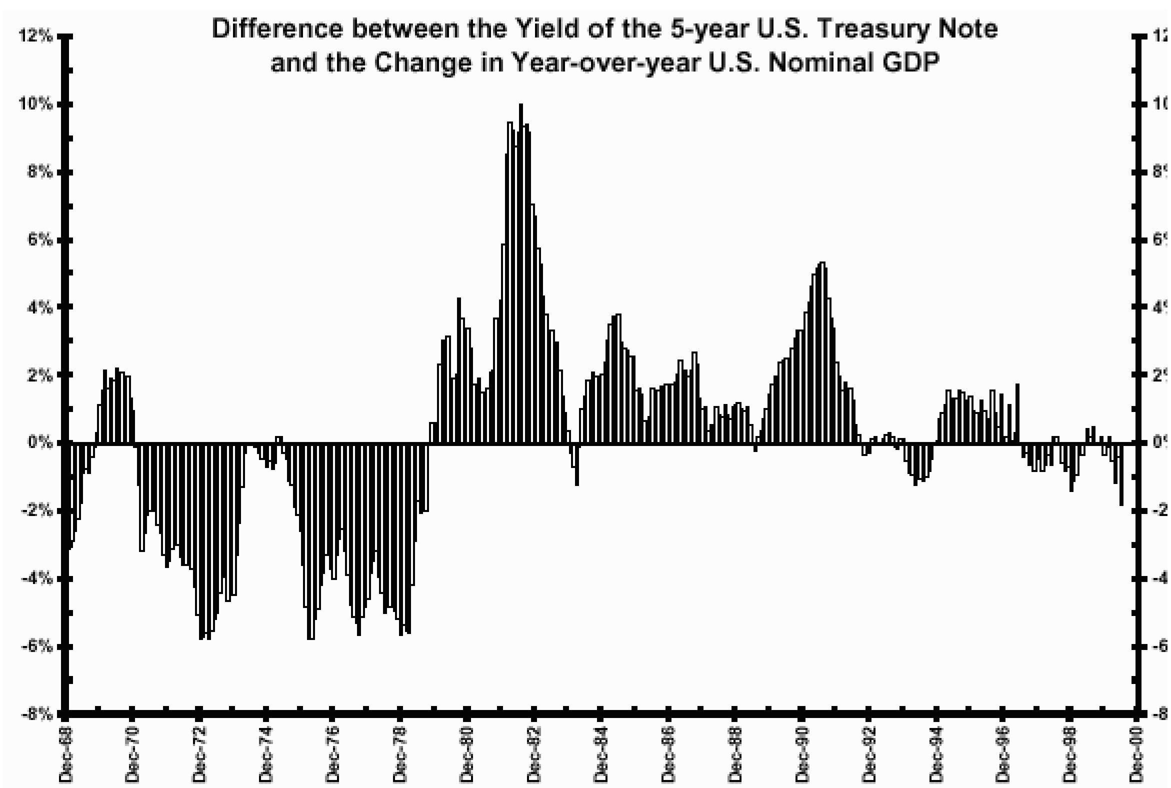
> "Think of this measure as an asset valuation model with the asset being the entire economy. If the asset, as measured by nominal GDP, returns a rate higher than the prevailing interest rate (the five-year Treasury note), then it makes sense for a business to borrow and expand. One can make money in such an environment because the asset has a higher return than the cost of borrowing. This will cause an increase in the demand for credit thus putting upward pressure on the price of credit— interest rates. This will last as long as yields are below the year-over-year change in nominal GDP (or at least the perception that interest rates are below nominal GDP). On the flip side, if interest rates (five-year Treasury note) are higher than the returns provided by the economy (nominal GDP), then borrowing to "buy" is a money- losing proposition. In this case the demand for money will fall because the profit incentive is not present. This will drive the price of credit (interest rates) down so long as yields are above the growth rate, or perceived growth rate, of nominal GDP."

It's not too difficult to nitpick this one. Why the five-year Treasury rate? Why not T-bills? Junk bonds? (After all, most unseasoned companies are not creditworthy, particularly these days.) Expected stock returns? You get the idea. But superior hypotheses are easily testable, and this one passes with flying colors. Here's the data, reproduced with the kind permission of the author.

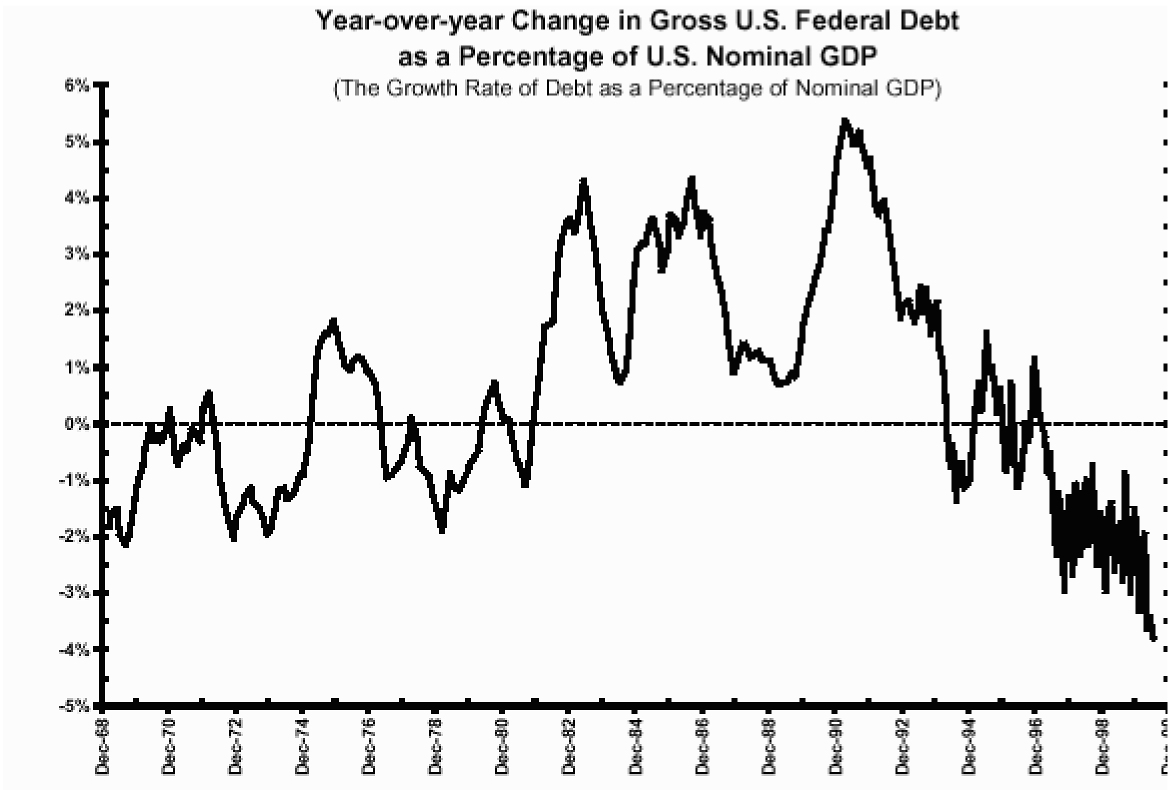
The below plot shows the raw data: the five-year Treasury and year-over-year GDP change:



The agreement between the two is good, but far from perfect, as you might expect given the fact that we're looking at a frequent sampling interval. The below plot is the difference between them.



This plot certainly seems to mean-revert around the zero value. The last plot explains the short-term gap between theory and practice: a high rate of new debt issuance will cause interest rates to be higher than GDP growth, and vice versa:



But what is remarkable is that a supply of new Treasuries only temporarily perturbs the equivalency between GDP growth and interest rates; the fundamental relationship between the two persists. Bianco locks up his case with nearly identical data from Japan, the U.K., Canada, and Australia. The Japanese data are particularly powerful, as they explain their bizarrely low interest rates as a consequence of the zero economic growth of the past decade. The importance of this cannot be overstated. Most economists rank debt supply as the primary mover of interest rates, with economic growth exerting only a secondary effect, and not the other way around.

Now the punch line: the long-term equivalency of interest rates and GDP growth supplies us with a way of estimating the equity premium with breathtaking simplicity. This is because long-term corporate earnings and dividend growth must also be equivalent to GDP growth. And since long-term equity returns are closely approximated by the sum of dividend/earnings growth and the dividend rate, then *the equity premium is simply the dividend rate.* In other words, since in the long run it is approximately true that:

Treasury yield = GDP growth = Corporate dividend/earnings growth

And that:

Expected equity return = Corporate dividend/earnings growth + Corporate dividend rate

Then, it must be so that:

Stock return – Treasury yield = Equity premium = Corporate dividend rate

(For the purposes of this paper I've avoided the term "equity risk premium," as this properly refers to the stock return in excess of the risk-free T-bill rate.)

It's just that simple. From 1926 to 1994 stocks returned 5% more than Treasury notes—almost exactly the average dividend rate for the period. And going forward, in the very long term, you're gonna get all of a 1.3% excess return over bonds.

The problem is that on a day-to-day basis you get your return from multiple (PE) change—so-called "speculative" return in Bogle's terminology. But over the ages your return is dividends plus growth, Bogle's "fundamental" return. The trick is to think like Samuelson, Sharpe and Bogle, not like the Three Stooges. Is 1.3% an adequate reward for favoring stocks over bonds? You be the judge.

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William J. Bernstein

Credit Risk: How Much? When?

I'm often asked about the place of junk bonds in a diversified portfolio. The standard Chicago-Santa Monica answer to this question is, "Never, ever: Bonds should always be short and of very high quality. Yes, there is a premium from junk bonds, but over the long haul it is not large enough to justify the extra risk. Further, junk has a high correlation with small stocks, so it offers little diversification value." But high-yield is a remarkable asset class and worth examining, particularly regarding its default rates and expected returns.

Consider a portfolio of B-rated bonds yielding 14%; typically, these are bonds which currently are paying their coupons, but have a high likelihood of defaulting or have done so in the recent past. A Treasury bond of similar duration yields 5.5%. Thus, in this example, the Junk-Treasury Spread (JTS) is 8.5%.

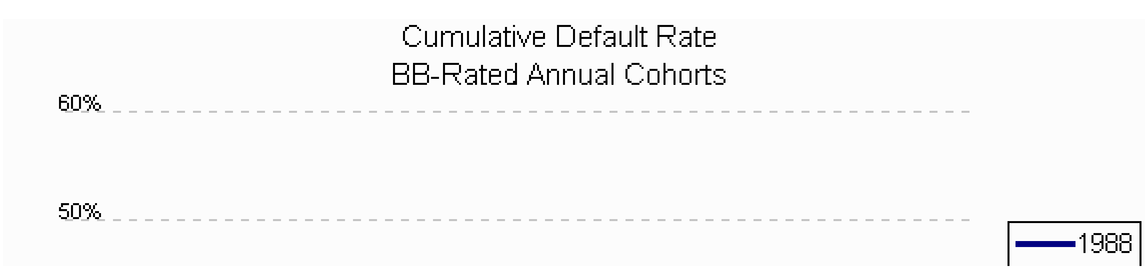
Now, let's take a look at the spread's history over the past 13 years. (I'm indebted to Jay Diamond at *Grant's Interest Rate Observer* for this data.)

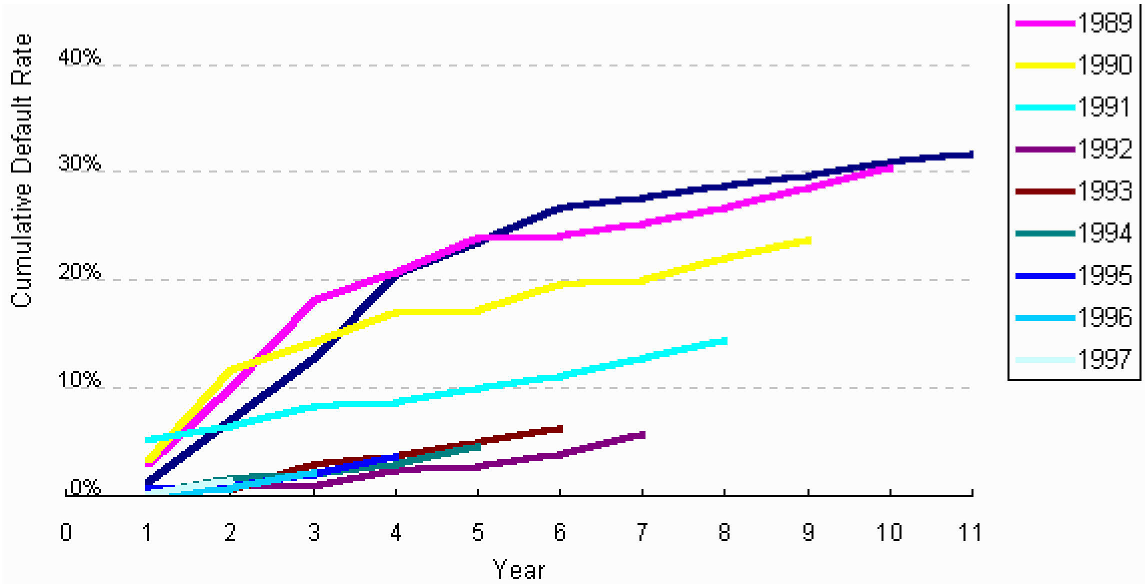
The spread depicted in the above graph corresponds roughly to B-rated debt. Note the very wide range of spreads from just under 3% to almost 10%. What does a JTS of 3% mean? Very bad news for the junk buyer, because he or she will have been better off in Treasuries if the loss rate exceeds 3%. And even if the loss rate is only half of that, a 1.5% return premium does not seem adequate to compensate for this risk. There is a wealth of data out there on the bankruptcy/default rate of these beasts, allowing us to evaluate whether the prevailing risk premium amounts to adequate compensation.

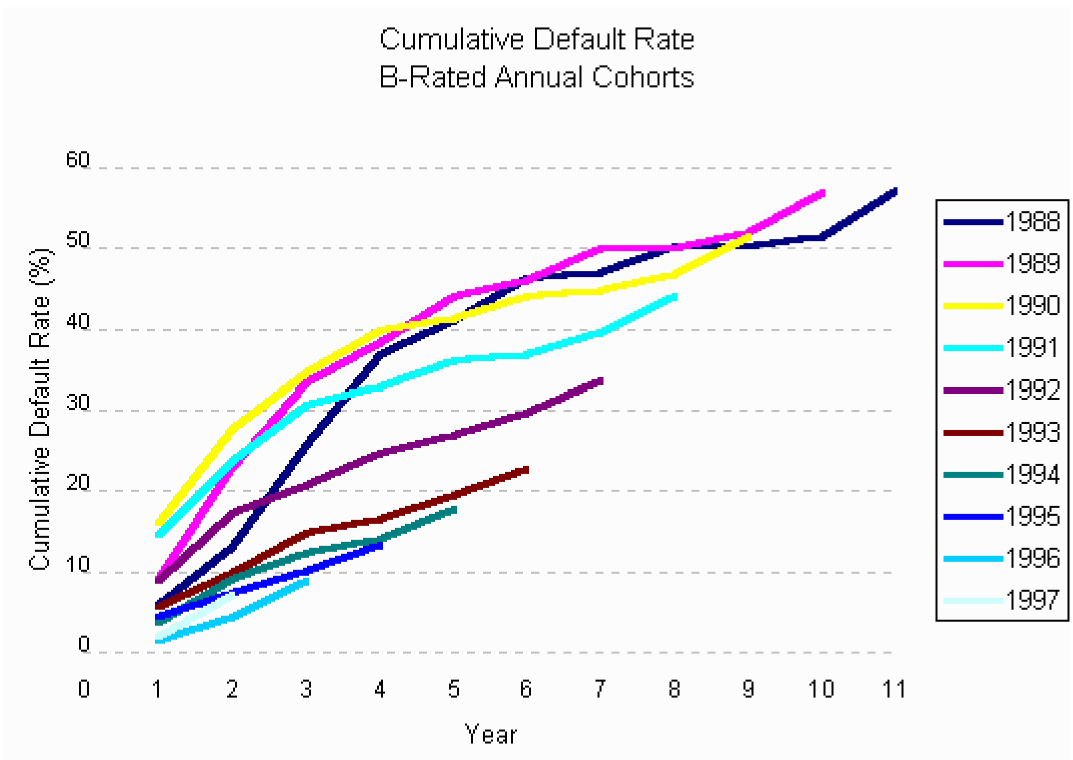
It's important to briefly discuss the meanings of *default rate* and *loss rate*. The former is obviously the proportion of companies defaulting per year. But not all companies that default go bankrupt. The *recovery rate* is the proportion of defaulting companies that do not eventually go bankrupt. So a portfolio's reduction in return is calculated as the default rate times one minus the recovery rate: if the default rate is 4% and the recovery rate is 40%, then the portfolio's total return has been reduced by 2.4%. The *loss rate*, how much of the portfolio actually disappears, is simply the default rate minus the absolute percent of companies which recover.

According to Moody's, the annual long-term default rate of bonds rated BBB/Baa (the lowest "investment grade") is about 0.3%; for BB/Ba, about 1.5%; and for B, about 7%. But in any given year, the default rate varies widely. Further, because of the changes in the high-yield market that occurred 15 years ago, the pre-1985 experience may not be of great relevance to high-yield investing today. Before the advent of Michael Milken, the overwhelming majority of speculative issues were "fallen angels"—former investment grade debt which had fallen on hard times. But after 1985, most high-yield securities were speculative right from their initial offering. Once relegated to bank loans, poorly rated companies were for the first time able to issue debt themselves. This was not a change for the better. Similar to speculative stock IPOs, these new high-yield bond issues tended to have less secure "coverage" (an ancient accounting term defined as the ratio of earnings before-taxes-and-interest to total interest charges) than the fallen angels of yore, and their default rates were correspondingly higher.

In the halcyon years of the late '80s, deals of increasing dubiousness got done, with predictable results for bondholders. Default rates did decrease in the 1990s, but they probably will soon be rising again. In any case, it seems likely that the period from 1988 to 1997 represents a full "credit cycle," and it is useful to examine the cumulative default rates of BB and B-rated bonds over this period.

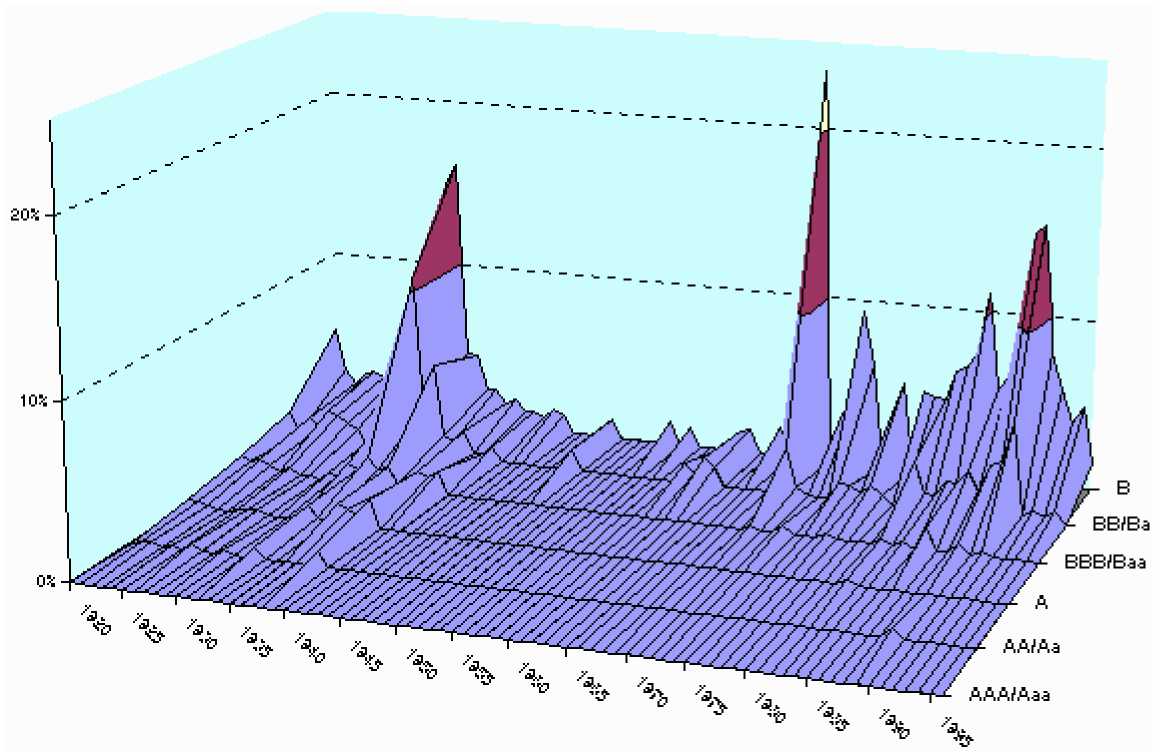






The BB-rated bonds seem to default at about 2% per year, on average, and the B-rated bonds at about 4% per year. Of course, rates can temporarily be much higher: even 8% to 10% per year at times for B-rated debt. Remember, default does not mean total loss though; about 40% of defaulted debt is eventually recovered. So reckon about a 1.2% annual long-term loss rate for BB-rated, and about 2.5% annual for B-rated.

Finally, there is the issue of *default-rate volatility*. A debt portfolio with an average yield of 10%, a default rate of 5%, and a recovery rate of 50% is mathematically identical to a risk-free asset with a yield of 7.5%. The problem is, defaults are unpredictable and therefore demand a risk premium. Default-rate volatility can be measured conventionally with standard deviation, with one caveat: default rates are serially correlated (that is, they tend to trend), so the SD understates this risk a bit. The below chart (courtesy of Alexandra Berthault of Moody's) beautifully demonstrates both the volatility and trending phenomena.

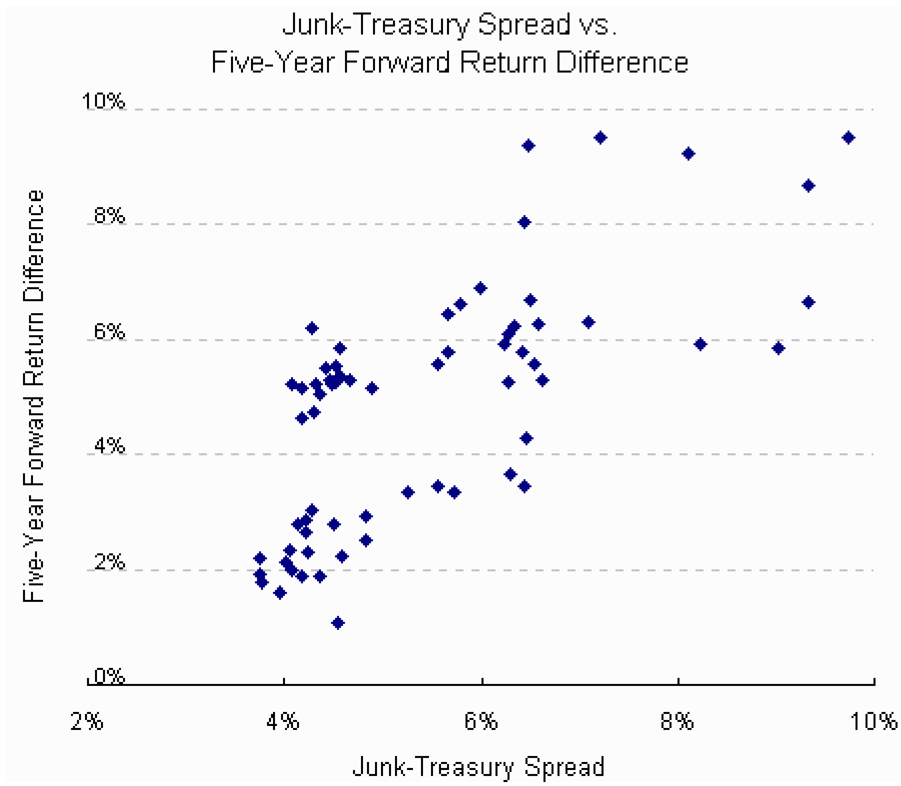


We now have the tools to rationally investigate high-yield investing. The risk premium of junk is simply the JTS (Junk-Treasury Spread) minus the loss rate. To begin, take a look at the graph depicting the cumulative default rate of B-rated bonds. Is it rational to invest in a portfolio of B-rated high-yield securities that offers a 3% yield premium over treasuries? (Northeast Investors Trust and Fidelity High Income, for example, are overwhelmingly composed of B-rated bonds.) Only the dullest of blades would do so. With an annual default rate of roughly 7% and a recovery rate of 40%, we're losing about 4.2% of return (3% minus [.6 x 7%]) per year. So we're doomed here to a return lower than Treasuries, at much higher risk. Historically, the JTS is about 4.5%, and even this does not provide an adequate return premium (4.5% minus [7% x .6] is 0.3%). This is the reason why most pundits recommend that long-term investors stay away from junk.

However, in late November, the Junk-Treasury Spread was at 9%; at that level, things look different. Running the same calculation, we subtract from 9% a loss rate of 7% times .6 and get a risk premium of 4.8%. In fact, this sort of analysis understates the case since it does not take into account potential market-value change. A JTS of 3% leaves little room for further narrowing of the spread—it's much more likely to rise, which will result in price fall and further erosion of return. Contrariwise, a JTS of 9% is quite likely to narrow, resulting in price gain.

Junk bonds are different from stocks in one substantial aspect: a stock or stock market cross-section can remain cheaply valued or richly valued for decades. There is no fundamental reason, for example, why REITs yielding 8% or industrials yielding 1.3% should not continue to do so for decades. *But a distressed bond selling at 60% of par with a maturity of eight years which does not default must of necessity yield its coupon plus a capital gain of 67% after eight years.* In other words, in the long term the only way of being burned with a properly diversified high-yield portfolio is if the future average default rate is much higher than has been the case in the past. And remember, the recent past includes the 1989-91 debacle, the worst in high-yield history.

Below I've plotted the JTS versus the forward five-year difference in returns between junk and Treasuries.



There's a pretty clear-cut relationship here: As expected, the higher the spread, the greater the advantage of bearing credit risk.

For a believer in efficient markets, these conclusions are profoundly disturbing, but not unprofitable. Although most of the time, it does not pay to take credit risk, there are periods when expected returns are too high to ignore. Yes, the devout efficient marketeer will point out that there's a reason why one does not often find $10 bills lying on the sidewalk, and that if this junk-bond opportunity were really a free lunch, it would have been arbitraged out long ago. However, there are limits to arbitrage. I ran smack into this limit at a conference of institutional fixed-income managers recently. It was easy to pick out the "spread investors"— they were the ones with the deer-in-the-headlights stare and the portfolios suffering from the bond equivalent of irresistible-force-meets-immovable-object. I'm talking about huge mutual-fund-redemption demands running smack into illiquid, impossible-to-price securities. If you're an small investor with a modest portfolio exposure to junk, say 1% to 2%, you can afford to wait a few years for prices to recover. These folks looked like they didn't even have a few weeks.

Belief in the efficient market theory does not relieve one of the duty to estimate asset-class returns. Because of the term structure of high-yield bonds, returns will tend to mean-revert more quickly, and more surely, than equity. Yes, there is risk. But when their long-term expected returns start approaching 5% over Treasuries (as they did not so long ago), it looks like a risk worth taking with a small corner of one's portfolio. One caveat: Because most of the return, similar to REITs, accrues as ordinary income, junk bonds are appropriate only for tax-sheltered accounts.

Are we market timing? I suppose. It's the lesser of two evils—I'd rather violate the efficient market hypothesis than ignore appealing expected returns with a relatively short time horizon.

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William J. Bernstein

Of Math and History

I'll admit that *Efficient Frontier* isn't for everyone. Most of my friends take a peek, chuckle, and move on, saying something like, "Bill, ole buddy, it looks like you're having fun, but I don't understand a word of this. There's just too much math." Fact is, almost all our readers fall into three broad categories: finance professionals, scientists or engineers, and other professionals who are good with numbers.

I'll also admit that it's the engineers who most often give me the willies. Human nature mandates that we overvalue those abilities that we possess in greatest abundance. If you were the prom queen, then you tend to overemphasize the importance of physical appearance. If you were the school jock, you tend to judge people by their athletic ability and locker-room behavior.

And of course, if you're a math whiz, then all of life's problems can be solved by spinning proofs and running the numbers. Not a week goes by that I don't get a spreadsheet from someone demonstrating how this allocation or that strategy led to great riches over the past five, twenty-five, or seventy years.

The trouble is, markets are not circuits, airfoils, or bridges—they do not react the same way each time to a given input. (To say nothing of the fact that inputs are never even nearly the same.) The market, though, does have a memory, albeit a highly defective kind, as we'll see shortly. Its response to given circumstances tends to be modified by its most recent behavior. An investment strategy based solely on historical data is a prescription for disaster.

The Long Term Capital Management episode is a perfect example. First, find the brightest mathematicians and financial economists you can lay your hands on. Next, put all of them in the same room. After a while, they convince each other that their exceptional quantitative skills are the financial fountain of youth. Finally, supply them with a few supercomputers and several years of highly detailed financial data. Shake well. Result: a financial doomsday machine.

This is not to minimize the importance of mathematical ability in investing— it's certainly *necessary* for financial success. It's just not *sufficient*. What's also needed is an historical sense of just how chaotic and random financial markets are.

If you're going to invest your own money, or other people's money, you simply cannot learn enough about financial history. The dullest and most essential part is absorbing the numbers: go to your library and look at Ibbotson's *Stocks, Bonds, Bills, and Inflation* until your eyes cross. (It will happen in just a few minutes.) This will give you an idea of how the basic stock and bond classes behave. Log onto Bob Shiller's and Ken French's Web sites; download and internalize their data on U.S. equity returns. Most investors make the mistake of focusing on historical long-term asset class returns. The real utility of the historical record is the vivid picture it paints of the chaotic nature of security volatility.

The descriptive history is the fun part. I used to recommend that folks start with Charles Mackay's *Memoirs of Extraordinary Popular Delusions and the Madness of Crowds*, but recently it's been superceded by Edward Chancellor's *Devil Take the Hindmost: A History of Financial Speculation.* It's much more contemporary and is pure "mind candy." Lastly, I highly recommend Jim Grant's trilogy of vignettes from *Grant's Interest Rate Observer*: "Money of the Mind," "Minding Mr. Market," and "The Trouble with Prosperity." If you ever have the opportunity to hear this man speak, you should avail yourself. Grant is even more entertaining and educational in person than in print, if that's possible.

This pleasure was recently mine. Grant's topic, as always, the current state of the bond market. He spun a fascinating story of corporate malfeasance and amnesia in the DuPont-Conoco tango. Anyone who buys or sells capital clearly ignores this saga at his own peril.

Jim transported us in the "Wayback Machine" to 1981. Commodities prices, particularly oil, were sky high. Interest rates were even higher, with long Treasuries near 16% and T-bills briefly in excess of 20%. (And because Mr. Grant generally does not discuss stocks in polite company, he did not note that during the 15 years prior to 1981, stocks had had the same return as T-bills and inflation.) DuPont, fearful of being at the mercy of the petrochemical producers which supplied their raw materials, decided to buy their own: Conoco. It was the biggest corporate takeover to that point in time. Unfortunately, DuPont did not have the requisite cash on hand and went to the debt markets, selling several billion dollars of debentures at coupons averaging 18%.

In retrospect, a truly awful decision: DuPont borrowed at the historical apogee of U.S. interest rates to buy an asset whose value had peaked. But it was actually worse than that—seventeen years later they then spun Conoco off with bond yields and petroleum prices at historic lows. The punch line was supplied by Mr. Grant, who asked DuPont at the time of the recent spin-off, "Did the company have any comment on their rather ironic sense of timing?" The answer: No comment, since *no one currently in their high command was around at the time of the original acquisition*.

A spectacular example of institutional amnesia and an excellent object lesson for individual investors. Both Grant and I were around, as they say, at that time, and the memories of an era when commodities were king and stocks and bonds were trash should serve us well in the long term, even if it hasn’t over the past decade. If you’re too young (or were too poor) to carry 1981’s scars, you can at least read about them.

The wheels don’t come off the wagon the same way each time. It’s unlikely that the next financial catastrophe will be a repeat of the hyperinflationary 1970s— it will have a pattern all its own. But read enough about 1981, 1974, 1929, and even the panics of the 19th century, and you’ll know that there’s more to investment planning than optimizing spreadsheets or taming a black box.

Efficient Frontier

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Link of the Month: T. Rowe Price's Retirement Calculator

I view actively managed stock funds with about the same attitude as a vegetarian on a field trip to an abattoir. But I'll admit to a soft spot for T. Rowe Price: their stock and bond portfolios are paragons of style and investment-policy consistency, and their commitment to asset-class-based investing, exemplary. Further, T. Rowe Price's advertising is intelligent and low-key. There's also a personal connection—almost a decade ago they provided me with my very first database of asset-class returns.

So I'm pleased to link to their excellent retirement calculator, which offers small investors a glimpse of Monte Carlo payout calculations. Take a look.

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